REMARKS/ARGUMENTS

Claims 1-3 and 5-21 are pending in this application. Claims 12 and 18 to 20 have been amended, and claim 4 has been cancelled. No new matter has been added with these amendments. In view of the remarks that follow, reconsideration, reexamination, and an early indication of allowance of claims 1-3 and 5-21 are respectfully requested.

Claims 1-21 are rejected under one of either 35 U.S.C. 102(b) as being anticipated by Vilnrotter ("Optical Receivers Using Rough Reflectors"), or 35 U.S.C. 103(a) as being unpatentable over Vilnrotter in further view of one of Gonsalves et al. (U.S. Patent No. 4,309,602), Wentz (U.S. Patent No. 3,740,560), Nayar et al. (U.S. Patent No. 6,864,916B1), Butt et al. (U.S. Patent No. 5,867,290) or Watanabe (U.S. Patent No. 5,896,211). Applicant respectfully traverses these rejections.

Rejections under 35 U.S.C. 102(b)

The Examiner contends that Vilnrotter teaches all of the limitations of all of the independent claims 1, 12, and 18 to 20. In addition, the Examiner contends that the Vilnrotter publication also teaches all of the limitations of dependent claims 2, 3, 9-11, 13, 14, and 16.

The claims of the current application, as amended each set forth a system or method for removing the effects of "atmospheric turbulence" that depends on "real-time" processing of detector outputs to optimize performance of the optical receiver. The important improvement of the instant invention over the prior art, as explicitly stated in the specification, is its ability to correct "signal degradation from atmospheric turbulence instantaneously and without significantly increasing interference from background radiation." (Specification, page 2, lines 14-16.) This system is directly contrasted with prior art systems that only allow for the processing of the "average PSF (point spread function) of the received signals over a relatively long period ... ." (Specification, page 2, lines 7-13.) In contrast, the Vilnrotter publication is directed to a static system

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designed explicitly to "determine the performance of optical receivers employing rough reflectors, and to develop techniques for improving receiver performance in the presence of interfering background fields." (Vilnrotter, page 2-9.) In particular, in the introduction to his paper, Vilnrotter writes:

> Diffraction-limited optical receivers provide the greatest protection against background interference, allowing the minimization of the receiver's field-of-view. However, it is generally both difficult and costly to construct large, diffraction-limited reflectors at optical wavelengths, hence our interest in the potential use of "rough" reflectors for optical communications. Thus, multielement reflectors designed for coherent operation at infrared wavelengths could be employed in a "photon-bucket" mode at much higher frequencies, or large, inexpensive reflectors with poor optical surface quality may at times be employed to collect signal energy. *Since "rough" reflectors typically scatter a significant fraction of the incident signal field, special processing techniques must be used to recover the scattered signal energy to improve receiver performance.*
>
> (Vilnrotter, page 1-1, emphasis added.)

In short, the Vilnrotter paper is not designed to deal with signals that are dynamically fluctuating as a result of completely unpredictable atmospheric turbulence, but rather is directed to a system to correct the performance degradation as a result of *static* and measurable errors in optics. For example, in describing the problem to be solved Vilnrotter specifies that the reflector can be modeled as a "isotropic random function with normal height distribution above and below the mean surface." (See, e.g., Vilnrotter, page 2-1, 2nd paragraph; and Fig. 2-1.) Accordingly, the "point spread function" calculated in the Vilnrotter paper at page 2-1 to 2-4 is not a result of a dynamic turbulence distortion, but rather the result of the actual flaws and distortions in the surface of the "rough" reflector. Indeed, in this section Vilnrotter specifies that the proposed system considers "only extended background sources that are characterized

by a spatially *constant* spectral radiation function ... due to a spatially *constant* background source... ." (Vilnrotter, page 2-4, emphasis added.)

As a result, nowhere does the Vilnrotter publication disclose a system for "real-time" optimization of an optical receiver to correct for "atmospheric turbulence," nor could the Vilnrotter method be modified to perform such a function. Specifically, Vilnrotter calculates an average distortion function over a period of time, and then uses this average distortion function to correct for the static distortions in the optics. For example, in discussing the operation of the prior art system, Vilnrotter writes:

> In order to transmit information over the channel, the transmitter modulates the intensity of the transmitted field, which results in a corresponding modulation in the intensity of the received fields. ... The receiver bases its decision on a fundamental array of observables, called counts, generated by each element of the detector array *over a suitable set of time intervals*, in response to the modulated received field.
>
> (Vilnrotter, page 3-1, emphasis added.)

In summary, the systems described by the Vilnrotter prior art is designed to take an *average* of a distortion over time, and then apply the average distortion function to the system. In contrast, the current system must take an instantaneous intensity distribution in "real-time" to address the constantly shifting distortion created by atmospheric turbulence. Accordingly, the Vilnrotter cannot be said to process detector outputs in "real-time" as required by each and every one of the amended independent claims of the current invention.

Furthermore, turning to independent claims 1 and 12, because the prior art Vilnrotter system is designed to correct the *static* problem of optic quality in a system, it is able use an average distortion function freeing it from the need to produce "real-time estimates" of signal intensity as required by claims 1 and 12. Specifically, in the current invention optimum weights are computed in real-time using an algorithm that estimates the SNR (See, e.g., FIG. 11). In contrast, nowhere in the Vilnrotter paper is an algorithm provided that would be capable of such real-time computation of optimum

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weights. The Examiner cites to Equation 2.3a and page 2-4 of the Vilnrotter paper as teaching these elements, but a detailed examination of this section of the paper clearly rebuts this argument. Specifically, this section is directed not to estimating in real-time estimates of power intensities, but rather, is directed to a method of correcting an incoming signal for the distortion caused by the "deviation of the actual surface [of the optic reflector] from its mean value." (Vilnrotter, page 2-1.) Likewise, Equation 2.3a is nothing more than an equation that can be used to "related the power reaching the detector array to the intensity of the optical field at the receiver." (Vilnrotter, page 2-4, lines 11-12.) In short, these equations are used to correct for the known static distortions of the optics. These equations are in no way related to the instantaneous estimates of weighting functions calculated by the system of the current invention to correct for the dynamic distortion caused by atmospheric turbulence as discussed in the specification starting at page 9, line 10.

In addition, all of the newly amended claims require the use of a square or rectangular array of detector elements. As discussed below, such a detection scheme is nowhere taught or even suggested by the cited prior art.

Finally, independent claims 12, and 18-20 each require that the signals be processed at the Nyquist rate. As discussed below, the system disclosed in the Vilnrotter system never teaches or even suggests such a high processing rate.

For all of the above reasons, Applicants respectfully submit that none of the newly amended claims of the application can be said to be anticipated by the detector system described in the Vilnrotter publication.

Rejections Under 35 U.S.C. 103(a)

The Examiner also rejects claims 4 to 8, 15, and 21 as being unpatentable over Vilnrotter either alone or in combination with a secondary reference. Claims 4 and 5 specify the use of a grid array of NxM. In contrast, the Examiner acknowledged that Vilnrotter merely discloses a system that uses circular elements. To rectify this deficiency the Examiner cites to Gonsalves; however, in no way can the method

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described in Vilnrotter be applied to a detector array of arbitrary dimension as proposed by the Examiner. Specifically, each and every algorithm and teaching in the prior art Vilnrotter publication assumes a system with circular symmetry. (See, e.g., Vilnrotter, page 2-8, 2nd paragraph; page 4-7, lines 3-7.) Accordingly, nowhere does the prior art Vilnrotter paper ever discuss, teach or even suggest using a square array grid of detector elements. Nor can Gonsalves be used to correct this deficiency in the original Vilnrotter paper. First, as previously discussed, Gonsalves and Vilnrotter address different problems in different contexts and call for different solutions. Gonsalves addresses the problem of wavefront error sensing and correction in an adaptive image system. Gonsalves proposes using an adaptive optics to focus the image of an object upon a detector array in an image plane, and based on it, provide an image signal set to an image signal processor. The image signal processor processes the image signal to provide an estimated wavefront phase error signal representative of the estimated deviation of the wavefront incident upon the image plane which includes the detector array, from an undistorted wavefront. The estimated wavefront phase error signal is delivered to a control system controlling the adaptive optics so that the error of the wavefront incident upon the detector array is reduced. (See, Col. 3, lines 18-32). Vilnrotter, on the other hand, addresses the problem of field distortion as a result of "rough" optics. (See, Vilnrotter, page 5-1). Vilnrotter proposes reducing the distortion under large backgrounds by processing the detected signals using average distortion functions. (Vilnrotter, page 3-1 to 3-2.)

Based on the above, Applicant submits that a person of skill in the art facing the problem addressed in Vilnrotter would not turn to Gonsalves for applying its teachings to solve the problem. Thus, contrary to the Examiner's position, a person of skill in the art would not be motivated to use Gonsalves' detector grid in Vilnrotter's circular optic system.

Second, a person of skill in the art would not be motivated to use Gonsalves' grid array because Vilnrotter already provides for a circular multiple detector array. (See,

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Vilnrotter, Section 4.1.3). There is no indication that the use of a square grid detector array in lieu or in addition to Vilnrotter's array would help Vilnrotter's optic correction.

Finally, the Examiner states that though Vilnrotter does not anywhere teach a system capable of processing signals at a rate equal to or greater than the Nyquist rate, as required by original claim 7 and newly amended claims 18 to 20, that such rate is the "minimum sampling rate required to reconstruct the original signal," and that thus it would have been obvious to one of ordinary skill in the art to operate at such a rate. (Office Action, page 7.) This rejection fails to recognize both the significant challenges posed by attempting to operate a signal processor at such a rate, and the systematic differences between the prior art Vilnrotter system and the current system to ensure that capability.

Specifically, as discussed above, the prior art Vilnrotter system is designed to correct for a static optic distortion by taking an average distortion function. (See, e.g., Vilnrotter, Sections 2, 3, and 5.) Of principal interest is Vilnrotter's discussion of the operation of the prior art decoder, which takes the "average count due to background radiation over the *n*th detector element and *l*th time interval." (Vilnrotter, page 3-2.) Accordingly, the prior art system does not suggest, and certainly does not require a sampling rate of at least the Nyquist rate for the proper operation of that system.

In contrast, the current invention is directed to a real-time system, and as such must conduct a number of additional processing steps in real-time to ensure that the dynamic fluctuations caused by atmospheric distortion are corrected. For example, the specification explains some of these necessary steps stating,

> Once the total intensity is measured by the detector the signal-processor operates on the signal to instantaneously determine the information contained therein. To accomplish this signal processing, in one embodiment, at the end of T sec, the signal processor assembly estimates the signal intensity and then computes the probability of having received the observed array of count accumulator functions and selects the

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message corresponding to the greatest probability of having been received.

(Specification, page 9, lines 10 to 15.)

Nowhere does the prior art Vilnrotter publication every disclose such instantaneous processing and real-time SNR estimation. Accordingly, one of ordinary skill in the art would have had no motivation, and indeed no teaching on how to run the prior art Vilnrotter system at the Nyquist rate, as required by claim 7 of the current application.

Conclusion

In view of the above amendments and remarks, Applicants submit that independent claims 1, 12, and 18 to 20 are allowable over the prior art Vilnrotter reference. Claims 2-11 and 13-17 are also in condition for allowance because they depend on an allowable base claim, and for the additional limitations that they contain. Accordingly, Applicant respectfully requests reconsideration, reexamination, and an early indication of allowance of claims 1-3 and 5-21.

Respectfully submitted,
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